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ABSTRACT

Instructional materials are provided for a unit dealing with production and marketing of wood as an energy source. Unit objectives and a list of visual masters appear first. Content is arranged by six topics: introduction, pre-cutting activities (planning a fuelwood cutting, marketing, chain saw safety), cutting activities, post-cutting activities, nontraditional wood for energy uses, and a fuelwood business. For each topic, objectives, teaching procedure(s), and a list of activities are presented. A listing of suggested references is included. Other contents include the technical information to be read in conjunction with the topics (with references and study questions) and transparency masters. (YLB)

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WOOD AS ENERGY-
PRODUCTION AND MARKETING

Instructional Materials Developed

for

Iowa Teachers of Vocational Agriculture

Prepared by:

DEPARTMENTS OF FORESTRY AND AGRICULTURAL EDUCATION

IOWA STATE UNIVERSITY

AMES, IA

June, 1986

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The following individuals contributed to the development of these instructional materials.

The project and writing staff:

W. Wade Miller, Associate Professor, Department of Agricultural Education, Iowa State University

Steven V. Jungst, Professor and Chair, Department of Forestry, Iowa State University

Reinee E. Hildebrandt, Extension Assst., Department of Forestry, Iowa State University

Stephen G. Eckles, Research Asst., Department of Agricultural Education, Iowa State University

Advisory committee:

W. William Farris, Asst. State Forester, Forestry Division, Iowa Conservation Commission

C. William Ritter, Regional Forester - Eastern Iowa, Forestry Division, Iowa Conservation Commission (Also a member of Iowa Christmas Tree Growers Assn)

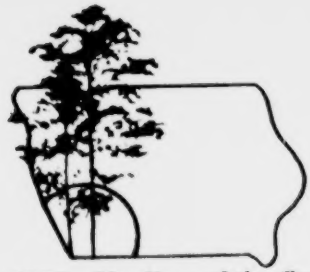
Dean R. Prestemon, Extension Forester, Iowa State University

Paul H. Wray, Extension Forester, Iowa State University

Charles R. Moench, Director, Area Schools Division, Department of Public Instruction (Also a member of Governor's Task Force on Agricultural Diversification)

Wayne Nattress, Consultant, Career Awareness and Exploratory Services Unit, Department of Public Instruction

Ronald R. Ruess, Teacher of Vocational Agriculture, Anamosa Community School District



1986 - The Year of the Tree

WOOD AS ENERGY

PRODUCTION AND MARKETING

UNIT OBJECTIVES

Upon completion of this unit the student should be able to:

1. Explain how wood for energy production can help improve our woodlands.
2. Explain what a person should know before they begin cutting down trees for fuelwood.
3. Determine the proper steps to take in cutting down trees for fuelwood.
4. Explain the post-cutting activities a person should do before marketing or utilizing fuelwood.
5. Determine strategies for marketing fuelwood.

VISUAL MASTERS

1. What is a Cord?
2. Cord Determination.
3. Heat Potential of Wood.
4. Rating for Hardwood Firewood.
5. Benefits of Iowa's Woodlands
6. Trees to Remove for Firewood.
7. Spacing Crop Trees.
8. The Right Cuts.
9. Steps in Preparing Wood for Use and Market.
10. Chain Saw Parts
11. Different Wood Splitters.

ACTIVITIES

1. Cord Determination #1
2. Selecting the right tree
3. Cut that Firewood, Sammy!

Prepared by:
Reinee E. Hildebrandt
W. Wade Miller
Stephen G. Eckles

TOPIC 1 - INTRODUCTION AND INTEREST APPROACH

Objectives:

1. Define the terms: BTU, standard cord, face cord, rick, cubic foot.
2. Determine the number of cords in a given stack of wood.
3. List the top three tree species for providing the most BTU's/cord.
4. Determine which species provide the most BTU's per acre per year.
5. Explain the relationship between weight and amount of heat per species.
6. Explain the effect of log size and uniformity on the actual cubic foot content of a cord of wood.

Teaching Procedure:

1. Have students read technical information entitled Wood as Fuel. Summarize "Background Information" and "Measuring Firewood" sections.

2. Refer to visual "What is a Cord". Help the students determine a cord.

3. Activity 1: Take the class to a pile of wood. Divide the class into two groups. Have one group stack a standard cord of wood and the other stack a face cord of wood. Have each group measure the appropriate dimensions of each cord. Ask them which cord they would rather purchase if each sold for the same price.

4. Refer to visual "Cord Determination". Activity 2a: Use the "Cord Determination" activity sheet.

5. Take the class to three large stacks of firewood. Divide the class into three groups. Have each group determine the number of cords in their stack.

6. Summarize "Heat Value of Different Wood Species" in Wood as Fuel. Use the visuals: "Heat Potential of Wood" and "Rating of Hardwood Firewood".

7. Activity #3: Determining Cubic Foot Content.
   a. Using the stacks of wood from Activity 2, have students determine the cubic foot content by placing a 1/2" square wire mesh over end of cord.
   b. Have students count the number of squares that have at least 1/2 total air space.
   c. Have students determine the total number of squares.
   d. Divide the number of squares containing air space by the total number of squares to obtain the percent of the volume that is air space.
   e. Take the resulting number and multiply it with the total cubic foot volume of a cord (128 cu. ft.) to find out the total cubic feet volume of the stack of wood.

8. Do optional experiments (Ease of Splitting, Rate of Burning, Weight, Wood Comparison).

TOPIC 2 - PRE-CUTTING ACTIVITIES

Objectives:

1. Define: weed trees, TSI, wolf tree.
2. Explain how firewood cutting can affect timber resources.
3. List four criteria for selecting trees to be thinned out.
4. Describe how removing trees for firewood can enhance the development of the timber stand.
5. Visit a wooded area to:
   a. identify trees
   b. determine if a given stand needs to be thinned.
   c. mark appropriate trees for firewood production or develop a timber cutting scheme that considers Timber Stand Improvement (TSI) for saw log production, recreation, or wildlife.
6. Assess the potential market for firewood in your area.
7. Describe alternatives for marketing firewood
8. Develop a marketing strategy.
9. Explain how to properly use a chain saw (include safety requirements):
   a. list the parts of a chain saw.
   b. list safety considerations in operating a chain saw.
   c. list the steps in chain saw maintenance.

Teaching Procedure:

Part 1 - Planning a Fuelwood Cutting

1. Ask your district forester to talk to the class about TSI.

2. Have students read the technical information entitled Pre-Cutting Activities.

3. Discuss the information in Pre-Cutting Activities.
   a. Refer to visual "Benefits of Iowa's Woodlands" to show students the management objectives a person could adopt. Emphasize selecting trees for removal that help meet management objectives.
   b. Refer to visuals "Trees to Remove for Firewood" and "Spacing Crop Trees" to show tree selection for timber stand improvement.

4. Activity #1: Selecting the Right Trees. Use activity sheet "Selecting the Right Trees". Have students mark an X through the base of the trees they would cut out.

5. Show slides (included with this unit) of common trees in Iowa.

6. Activity #2: Field Trip to Local Woodlot
   a. Explain how to use Extension Publication #Pm-970, "Key for Trees of Iowa".
   b. Take students to a local woodlot.
   c. Identify trees using the "Key for Trees of Iowa".
   d. Flag all weed trees, wolf trees, and trees of poor quality.

7. Activity #3: Quality Determination
   a. Randomly select 5 points on the woodlot (which was marked in Activity #2) and have students mark a 100' circle around each point.
   b. Have students count the total number of trees in each circle.
   c. Have students count the total number marked trees. Have students calculate the percentage of marked trees using this formula: Number marked trees / total trees * 100 = % of marked trees.
   d. If a district forester can attend, have him/her to help the students to determine if cutting out all of the marked trees open up the woodland stand too much. If the answer is yes, then the forester should help them determine the proper stocking level. To do this establish a list of criteria for cutting out trees and then prioritize the list from first to cut to last to cut.

Part 2 - Marketing

Teaching Procedure:

1. Use visual "Steps in Preparing Firewood for Market".

2. Activity 1: Market Determination
   a. Have students develop a marketing analysis survey that includes:
- who purchases firewood.
- the prices paid for firewood.
- what species of firewood are preferred.
- how firewood is sold in the area (truck load, bundles, etc.).
- determine how many people prefer to have firewood delivered and/or stacked.
   b. Have students survey a sample of the community and compile the results.
   c. Discuss the survey results and draw conclusions.
   d. Organize the conclusions into a marketing strategy.

3. Activity 2: Marketing Firewood
   a. Use the marketing strategy developed in Activity 1.
   b. Secure a source of firewood.
   c. Have students develop advertising fliers and a newspaper ad.
   d. Market the firewood to the community.
   e. Keep records of all transactions.
   f. Discuss and evaluate the activity.

Part 3 - Chain Saw Safety

1. Preview film on chain saw safety. Two appropriate films are: "Safety is No Accident" and "Do It Right". See the reference section. List on the board, the most important points from the film.

2. Refer to the points on the board and then show the film to the class.

3. Discuss the important points from the film.

4. Have the students read the technical information entitled Chain Saws.

5. Discuss the important points in Chain Saws.

6. Activity #4: Chain Saw Fashion Show. Have one student dress properly and one dress improperly for operating a chain saw. Have the class point out what is right and what is wrong.

7. Ask a local dealer to give a demonstration on the proper use of a chain saw, felling techniques, and safety.

TOPIC 3 - CUTTING ACTIVITIES

Objectives:

1. Diagram the proper way to cut down a tree.
2. Cut down enough trees to make a cord of firewood.
3. List 11 points to keep in mind while limbing a tree.

Teaching Procedure:

1. Have students read the technical information entitled Cutting Firewood.

2 Discuss the important points in Cutting Firewood. Use visual "The Right Cuts".

3. Field Trip (select one)
   a. Ask a commercial firewood producer (select a safety conscious person) to demonstrate tree felling.
   b. Observe the logging activity in the local area or attend a field day.

TOPIC 4 - POST-CUTTING ACTIVITIES

Objectives:

1. List the step-by-step process for preparing firewood for market.
2. Discuss the various ways to split wood. Include the advantages and disadvantages of drying firewood.
3. Explain the advantages of drying firewood.
4. List various ways to stack and dry wood.
5. List the proper drying procedure for firewood and explain the effect of length of time for drying on percent of heat efficiency.
6. Explain the benefits of proper firewood storage.
7. Properly split, stack, and dry a cord of firewood.

Teaching Procedure:

1. Have students brainstorm what steps they need to consider in marketing their firewood once it is cut.

2. Have students read the technical information entitled Post-Cutting Activities.

3. Discuss the important points in Post-Cutting Activities. Use the visuals: "Steps in preparing wood for use and market", "Different wood splitters"and, "How does it stack up?"

4. Activity #2: Log Splitting Demonstration. Ask a commercial firewood producer or log splitter sales representative to give a demonstration to the class on the proper use of a log splitter. If this is not possible consider a teacher demonstration.

TOPIC 5 - NON-TRADITIONAL WOOD FOR ENERGY USES

Objectives:

1. Define the terms: biomass, wood for energy, energy plantation.
2. List the types of biomass fuel
3. List the types of wood products used for biomass.
4. Explain what an energy plantation is.
5. List 3 species to plant in an energy plantation.
6. Plan an energy plantation:
   a. Species selection
   b. Spacing requirements
   c. Regeneration
7. Determine when to harvest the energy plantation crop.

Teaching Procedure:

1. Have students read the technical information entitled Biomass Production.

2. Activity 1: Biomass ID Quiz
   a. Obtain samples of the various wood biomass products.
   b. Number the samples and provide the names of the products to the students.
   c. Ask the students to name the products.
   d. Go over the names of the products with the students and explain the advantages and disadvantages of each product.

3. Activity 2: Energy Plantations
   a. Have students read the technical information entitled Energy Plantations. Discuss the most important points.
   b. Divide the class into groups of two and give each group a piece of graph paper (1/2" squares).
   b. Designate the scale for the squares and give the class symbols to use for different tree species.
   c. Have the students draw a plan for an energy plantation.
   d. Discuss the plans:
      - Number of species
      - Choice of species
      - Row spacing
      - Harvest rotation

TOPIC 6 - A FIREWOOD BUSINESS

Objectives:

1. Determine what records need to be kept for tax purposes.
2. Determine the cost of a cord of firewood.
3. Analyze the cost of various transportation methods.
4. List the types of accounts that need to be maintained.

Teaching Procedure:

1. Ask students which cord of wood costs more: a cord that was free from a woodlot 50 miles away or a cord that costs $25.00 that is 10 miles away.

2. Refer to Extension Publication F-335, "Cost of Cutting Your Own Firewood"

3. Activity #1: Do the "Cut that Firewood, Sammy!" activity.

4. Have students read the technical information entitled "A Firewood Business". Discuss this information bringing out the following points:
   a. The importance of keeping good records.
   b. What records need to be kept.
   c. Help the students understand how record keeping can affect the tax burden of a firewood producer. Contrast keeping records of cost of wood versus cost of wood plus other expenses listed in Activity #1.

5. Activity #2: Keeping records
   a. Have the class develop a record keeping system for an actual or simulated firewood business.
   b. Have the class determine their costs, revenue, and profit before and after taxes.

c. Have the class determine their tax burden if they did not use capital gains and/or only recorded the cost of the wood rather than including the cost of cutting the wood.

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WOOD AS FUEL*

Firewood production has become a popular alternate source of energy for many homeowners. Many people enjoy cutting firewood for the exercise, others do it out of economic necessity, while even others have developed successful firewood businesses. Since the increase in popularity of cutting firewood, some ofIowa's woodlands have suffered increased exploitation. Many people simply start at one end of the woods and cut to the other end. This practice simply eliminates our already scarce woodland resources. It is time people learned to extract firewood in a manner which will improve the quality of the woodlands and maintain their existence.

By cutting out the right trees, there is reduced competition for light, water, and nutrients among the trees which remain.

Background Information

Whether you intend to be a firewood consumer or producer, it is important to know about your product. First, how is the product sold? Firewood can be sold by the standard cord, face cord, truck full, bundle, or rick.

A standard cord is the most reliable measure of firewood. It is a stack of wood 8'x4'x4'. A face cord may look like a standard cord at first glance, since the length and height dimensions are 8'x4'. However, the width dimensions can vary from 6 inches to 4 feet. Therefore, if the same price is paid for a standard cord as a face cord the consumer could get short-changed by agreeing to purchase the face cord.

When a person buys wood by the truck load, the load size may vary from 1/4 a cord to 1/2 a cord. Truck loads sell for $35 to $75. The least economical way to purchase wood is purchasing it by the bundle. If figured on a per cord basis the bundle can cost as much as $350/cord.

Provided that you are dealing with only a standard cord, there are still variations in the actual cubic foot content, weight, and number of BTU's of energy each cord has. This variation is determined by the size and uniformity of the logs in the stack, plus the tree species.

A stack of large, uniform, cylindrical shaped logs will have less air space between logs than a stack of irregularly shaped logs. This means there will be more cubic feet of wood. Large, uniform logs also have less airspace than small, uniform logs.

The other major variable is the tree species used. If you have ever held an equal-sized piece of oak in one hand and basswood in the other hand, you know that there is a definite difference in weight of woods.

Weight per standard cord of Iowa hardwoods at 20 percent moisture content.*

Species of Wood	Weight (lbs.) per cord
osage orange	4800
black locust	4200
shagbark hickory	4100
white oak, ironwood	3800
red oak, white ash	3500
hard maple	3400
green ash	3300
red elm	3000
American elm, sycamore	2900
silver maple	2750
boxelder	2550
aspen, cottonwood, willow	2300
basswood	2000

* Information from Forestry Extension Pub. Pm-622 "Using Hardwood Firewood".

It is interesting to note that the heavier and drier the wood, the more BTU's (British Thermal Units) that species provides. The higher the BTU's, the longer the fire would burn. However, lower BTU rated woods will burn faster, but more intense and hotter than the high BTU woods. In Iowa the tree species with high BTU ratings include: osage orange, black locust, oak, and hickories.

If you are considering starting a timber stand for firewood you might want tc consider fast growing trees such as cottonwood, ash, basswood, silver maple and hybrid poplar.

These trees have lower BTU's per cord than other trees species, but from the standpoint of producing BTU's/acre/year, these trees are the most productive.

*References

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Study Questions

1. What is a standard cord?
2. What is a face cord?
3. What is the range of prices for:
   a. a truckload of wood
   b. a cord of wood
   c. a bundle of wood
4. If a stack of wood is 6' by 5' by 10', how many cords does it contain?
5. How does log uniformity affect the actual cubic foot content of a cord of wood?
6. What are three species that could be planted in an open area which yield the most BTUs per acre per year?
7. Which provides the most BTUs per cord, dry or wet wood? Why?

PRE-CUTTING ACTIVITIES*

Introduction

Most people who want to cut down timber simply start up the chain saw and begin cutting any tree in sight. It should be stressed that this is NOT a wise management practice.

Before the actual cutting activities begin the firewood cutter must know: 1) what species of trees are in the woodlot, 2) what the long term goals for the woodland are, 3) what the best criteria for selecting appropriate trees is, and 4) how to safely operate and maintain a chain saw (see Information Sheet No. 3).

Unless sound management practices are used, harvesting firewood could reduce the quality and quantity of forested areas. When people start at one end of a woodland area and cut to the other end they are only eliminating the area. Also, if the tallest and straightest trees are the only ones cut, then only poor quality trees remain. These poor quality trees will produce a new generation of poor quality trees. Planning a sound management strategy can help improve and maintain Iowa's woodlands.

Planning a Firewood Cutting

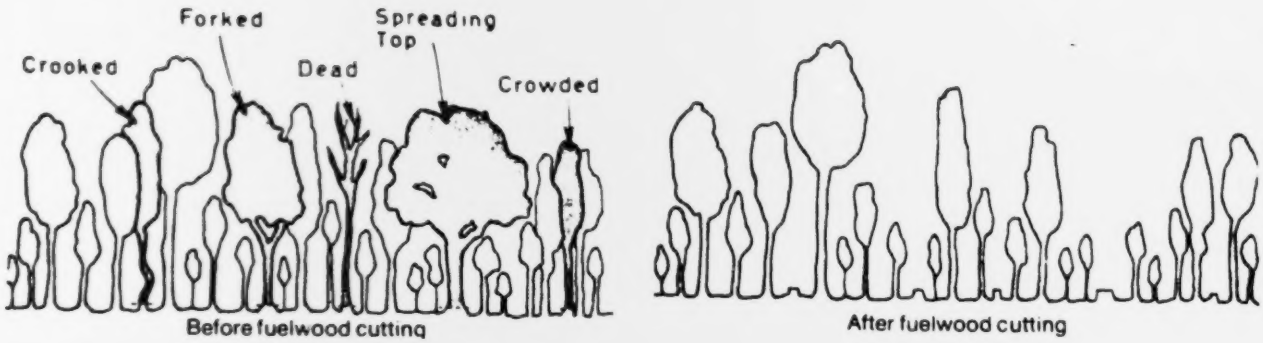
In planning for a firewood cutting the landowner must first determine his/her long term objectives for the woodlands. These woodland areas provide a multitude of benefits such as lumber or veneer logs, firewood, erosion control, beauty, recreation, and wildlife.

If the landowner wishes to produce lumber and veneer logs; or provide recreation, wildlife cover, beauty, etc.; timber stand improvement (TSI) should be used. This means the valuable trees will be identified, and the weed trees, wolf trees, dead trees and poor quality trees will be cut out for firewood.

Weed trees are trees that readily invade an area and take it over. They typically are fast growing tree species of little commercial value. Examples include ironwood, elm, and boxelder. Woodlots also typically contain "wolf trees." These trees are often the largest trees in the stand in terms of crown width and they take lots of growing space. Such trees are typically low quality for sawlogs because they are branchy and poorly formed, but they produce a large volume of firewood.

Periodic thinnings to provide adequate growing space for sawlog trees can produce material suitable for firewood. Undesirable species can be removed during the fuelwood thinnings. Crooked, damaged, or partly decayed trees should be harvested as a part of the stand improvement (Table 1). Trees removed during such periodic thinnings are often of ideal size for firewood. Splitting may not be necessary with these small trees.

Figure 1. Improve the value and productivity of a woodlot by harvesting fuelwood*.



Trees killed by insects or disease should also be harvested for fuelwood. Cut dead trees as soon as possible after they die to minimize deterioration from decay. However, if you wish to provide wildlife habitat, leave at least 4-7 dead trees per acre. These trees will become den trees or homes for song birds, raccoons, squirrels, and other wildlife.

Do not overcut stands when harvesting fuelwood. Seek help from a knowledgeable source to achieve the right stocking level. Maintain full tree cover on the land to optimize quantity and quality production. This is especially important if your objectives are for erosion control, beauty, and recreation. In a recreation area you will need to maintain at least a 50 to 100 foot buffer strip around trails, camp grounds, and other areas used for recreation. For erosion control purposes never clear an area within 150' of a river, stream, or other similar area. Very open stands are not desirable for either fuelwood or sawlog production. Open areas will produce trees that have long branches close to the ground. Verneer quality sawlogs are trees that have a clear straight trunk void of branches closer than 8 feet to the ground. That is what the landowner desires if the objective is sawlog production.

Existing woodlands may also be managed primarily for fuelwood production. Proper cultural techniques are similar to those used when sawlogs are the primary product, but the owner would typically manage for smaller diameter crop trees. A well-stocked, 5 to 10-acre stand should provide a continuous supply of wood sufficient to heat an average insulated home.

Marketing

If you want to market firewood, the first thing to consider is whether or not there is a market demand. In colonial days, wood was the principal heating fuel for homes. As recently as 1900, wood supplied almost half of the energy used in the United States. As coal and petroleum products became available, the use of wood for fuel declined. But with the advent of the energy problems in the 1970's the position of wood has changed once again. As a renewable resource, wood is again supplying heat in

many homes. Wood as an alternative or supplemental fuel is likely to increase in importance during the next few years. However, local demand for wood varies so it is wise to assess the market demand in the area.

Secondly, consumer preferences need to be considered. Find out how people in your marketing area respond to the following :

1. Price range they pay for firewood.
2. What species are preferred.
3. How they prefer to purchase firewood: bundle; face cord; cord delivered; stacked.
4. Length of logs desired.
5. Whether split or un-split logs are desired.
6. If they prefer the stack of wood to be all one species.

The answers to responses will help you to determine if it would be profitable to market firewood. The answers will also help you to determine a market strategy.

Third, determine marketing strategies. This includes: advertising, locating buyers, degree of service (i.e. stacked vs. not stacked), and transportation needs/costs. You also need to maintain business records on all transactions.

Conclusion

Iowa has district foresters who can visit your woodlands and provide landowners assistance in developing a woodland management plan. The district forester can also help you identify the trees in your woodlot. The key point is to plan for your firewood cutting so you don't end up diminishing the quality and quantity of the existing woodlands.

*Reference

Excerpts from: Prestemon, Dean R. and Paul H. Wray. 1980. Fuelwood Production. Pm-831. Cooperative Extension Service, Iowa State University, Ames, IA 50011. Used by permission.

Study Questions

1. List four things a person should know or consider before cutting wood for firewood.
2. What is a wolf tree?
3. List three weed trees.
4. Explain how firewood cutting can affect forest resources.
5. List four types of trees that could be removed for firewood.
6. Explain what TSI means.

CUTTING ACTIVITIES

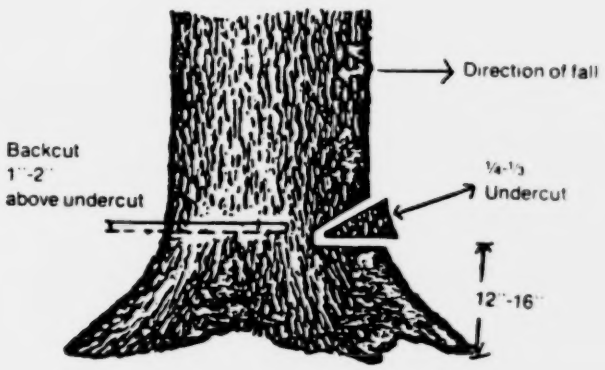
Your timber is marked. Your chain saw is in prime working order. So you're ready to cut down that tree. Right? Wrong. You're almost ready to take one last look around to size up your surroundings for dangers. You can never be too cautious. Now determine where it would be practical for the tree to fall. Look for an open area in a direction that gravity can help pull the tree over, and use this as the drop site.

Felling Trees

Now you're ready for the 3-cut process. This process consists of 2 undercuts, which form a v-notch in the tree and a backcut. The undercut is a v-shaped cut made in the direction you wish the tree to fall. This cut should be about 1/3 of the tree's diameter. The first cut of the v-notch should be placed 12"-16" from the ground. The second cut should be around 2 1/2" wide for each foot of the tree's diameter. For example, if the tree has a 24" diameter the second cut would start 5" above the first cut. It is important to note that any tree greater than 6" in diameter should never be cut without a proper undercut.

The backcut is a straight cut toward the undercut. The undercut should be located 1-2 inches above the first cut in the undercut. This provides a heavy hinge for controlling the kick back of the falling tree. Make sure you have good footing, an observant outlook and an escape path. Trees don't always fall in the direction you have planned. You may have misjudged the pull of gravity, the lean of the tree, the top-heaviness of the top, or an unpredictable wind could throw the tree being cut into an unplanned direction.

When the saw reaches within an inch or so of the notch, the tree falls toward the notch, turning on the hinge of wood that has been left. A wedge is often driven into the back cut to help move the tree in the right direction. Crooked or leaning trees present special problems and safety hazards. These trees should only be removed by professionals. Trees which fall and get caught up in other trees should be left alone until an experienced cutter can assist in dropping it to the ground.



Limbing the Tree

Once the tree is felled the next task is limbing the tree. Special care should be taken during this process since limbs are often under extreme tension. Below are 11 pointers to keep in mind when limbing a tree:

1. Keep a firm grip on the saw.
2. Have a good footing.
3. With small logs, stand on the side opposite the limb being cut.
4. If on a hillside, work on the uphill side.
5. Trees in lodged positions should be unlodged before limbing.
6. Watch the spring or jump of the limbs being cut.
7. Do not cut the limbs that are propping the log.
8. In limbing, work from the butt end of the tree toward the top. More accuracy can be obtained at the lower side of the limb than at the crotch.
9. The chain should be stopped when the saw is being carried over limbs and brush.
10. Use a chain designed for limbing or brushing.
11. Be alert for anything that can touch the end of the cutter bar and cause kickback.

*References

Excerpts from: Prestemon, Dean R. 1982. Chain Saw Safety. F-342. Cooperative Extension Service, Iowa State University, Ames, IA 50011. Used by permission.

Excerpts from: Prestemon, Dean R. and Paul H. Wray. 1980. Fuelwood Production. Pm-831. Cooperative Extension Service, Iowa State University, Ames, IA 50011. Used by permission.

Study Questions

1. Diagram the proper way to cut down a symmetrical, straight tree.
2. What is the first thing you should do before cutting down a tree?
3. List 6 points to keep in mind when limbing a tree.

POST-CUTTING ACTIVITIES*

Before marketing firewood, the wood needs to be split, seasoned, and stored.

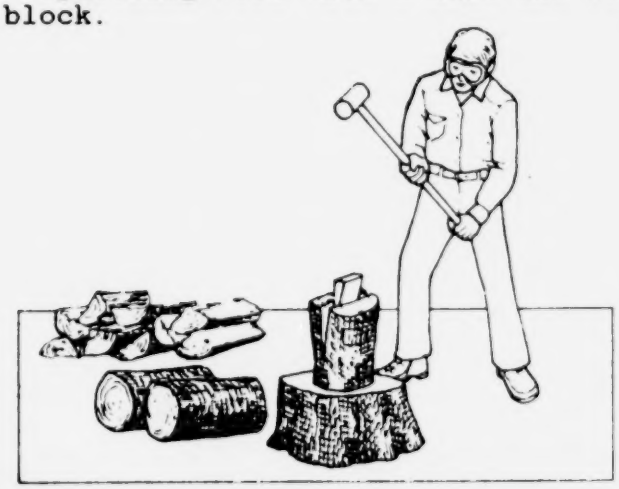
Splitting

Generally, firewood more than 6 or 8 inches in diameter should be split before burning. Splitting is usually easiest when the wood is green. Splitting may be done by hand, using an axe or splitting maul, or by using various types of mechanical splitters. As shown in Table 1, species vary in their ease of splitting; pieces containing knots are more difficult to split than clear wood. Use a heavy splitting maul alone or in combination with wedges to split firewood. A chopping block will provide a stable base and reduce tool wear (fig. 1).

Table 1 - Ease of Splitting

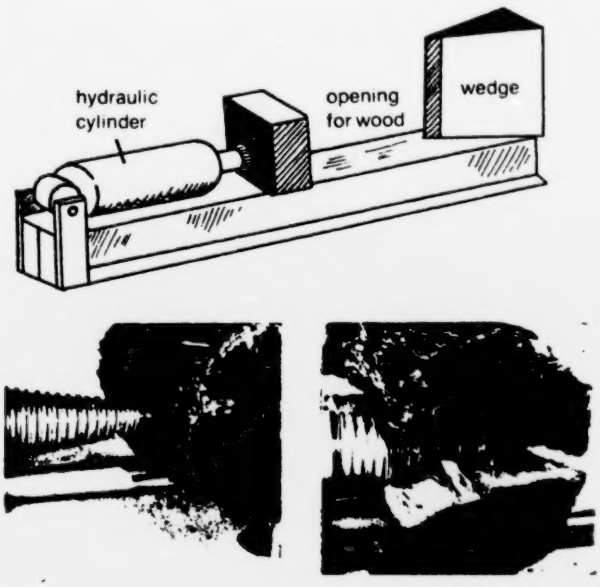
Easy	Moderate	Difficult
Aspen, ash basswood, birch, boxelder, cherry, cottonwood, willow	hard maple, hickory, oak, soft maple, walnut	black locust, elm, ironwood, osage orange, sycamore

Figure 1 - Splitting wood with a maul and wedge on a chopping block.



If a large amount of splitting is anticipated, mechanical splitters can be rented, built, or purchased. Available splitters are generally of three types: hydraulic powered, cable driven, or screw auger (fig. 2). Hydraulic and cable types use a similar technique - firewood is split by forcing a splitting wedge into the end of the piece. Screw auger types use a different method - firewood is fed laterally into the splitting screw. Homemade splitters may cost only a hundred dollars; commercial models may cost from $400 to $3,000.

Figure 2 - Hydraulic wood splitter (top) and splitting action of a screw auger type splitter



Seasoning Firewood

Proper drying of firewood is very important. Burning unseasoned wood is not recommended. Properly seasoned firewood has higher heat value per pound than green wood, is easier to ignite and maintain, is less prone to pop and throw sparks, and is less likely to promote creosote formation during burning.

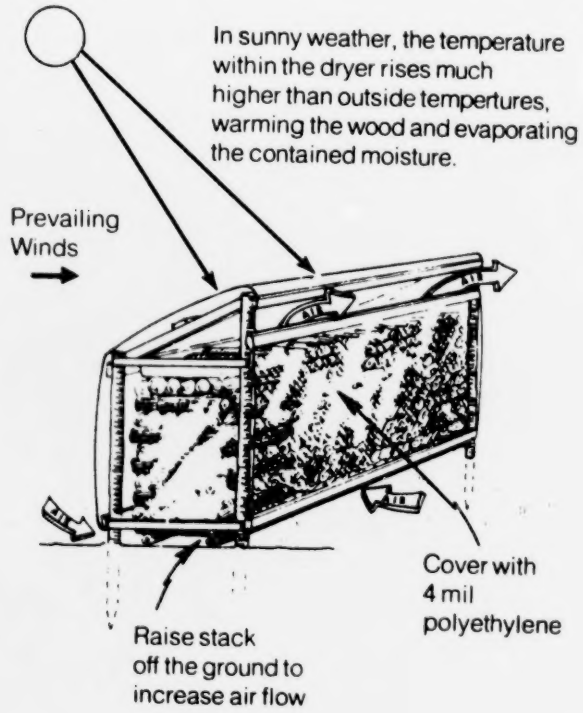
Fuelwood in 4-foot lengths typically requires 9 to 12 months to become thoroughly air-dry (20 percent moisture content). Small diameter, short lengths of firewood will dry more rapidly than long, large pieces. To increase drying rate, cut firewood to desired length and split oversize pieces.

Firewood dries more rapidly during late spring, summer, and early fall than during other months of the year. Severe end-checking and splitting that may occur on firewood during the hot summer months does not affect the fuel value.

Wood will become lighter as it loses water, and severe end checking usually develops during drying. Firewood should be dried to 20 percent moisture content or less. Moisture content can be checked by cutting a sample from the middle of a few pieces, weighing the samples, oven-drying the samples for 24 hours at 212 degrees F, and reweighing the samples. Moisture content is calculated by subtracting oven-dry weight from original weight, dividing the product by the oven-dry weight, and multiplying by 100.

Plans for solar firewood dryers have been developed (fig. 3). Such dryers will increase drying rate and can dry the wood to a lower moisture content than air-drying. A large solar drying unit has been developed in Virginia that dries a standard cord. Dryers may be useful for those who have limited time to dry their firewood and who do not intend to dry large quantities. But these units involve some time and materials to build.

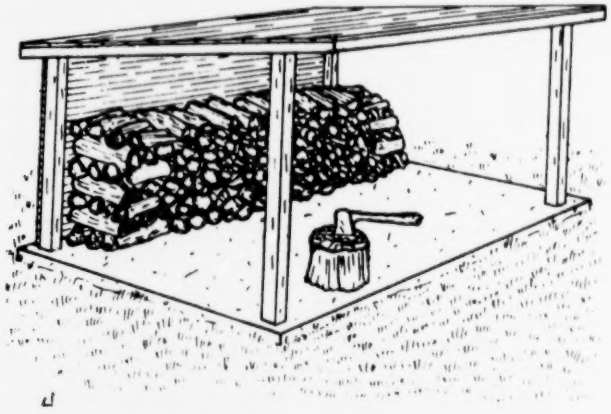
Figure 3 - A solar firewood drying unit.


In sunny weather, the temperature within the dryer rises much higher than outside tempertures, warming the wood and evaporating the contained moisture.
Prevailing Winds
Cover with 4 mil polyethylene
Raise stack off the ground to increase air flow

Storing Firewood

Store dry firewood under cover in an outside shed (fig. 4). Dry firewood will pick up moisture from rain and snow if not protected. Avoid storing large quantities in the house, warm garage, or basement - the increased temperature may activate fungi and insects. Limited inside storage near the stove, furnace, or fireplace that can be used for a week before burning to promote further drying and improve burning qualities.

Figure 4 - An open wood shed used to protect firewood during drying or for storing dry material.



*References

Excerpts from: Prestemon, Dean R. 1980. Using Hardwood Firewood. Pm-622. Cooperative Extension Service, Iowa State University, Ames, Ia 50011. Used by permission.

Excerpts from: Prestemon, Dean R. and Paul H. Wray. 1980. Fuelwood Production. Pm-831. Cooperative Extension Service, Iowa State University, Ames, IA 50011. Used by permission.

Study Questions

1. How should wood be prepared for market?
2. List three ways wood can be split.
3. Why should wood be dried?
4. How can wood be dried?

BIOMASS PRODUCTION*

Biomass in the broadest sense is solar energy stored in biological systems by the process of photosynthesis. Biomass uses include feed or food, a source of products for industrial manufacture (particle board is an example), protein production, the manufacture of chemicals, or fuel production. We will focus on the fuel production aspect.

Biomass as fuel finds three uses: 1) direct combustion, 2) conversion to more concentrated forms of ethanol or methanol, or 3) anaerobic digestion into methane. The direct combustion aspect is what will be discussed as it relates to wood use.

After a century of decline, the use of wood as an energy source is gaining in interest and application. Up until about the last 15 years, sawmill residues and wood bark were regarded as an abundant nuisance in the logging regions of the U.S. and Canada. Lately this has changed as these "wastes" are being burned to provide heat, steam for electricity, or increasingly as a source of fiber for such wood products as particle board. Biomass use as an energy source has become quite popular due to the high price of oil and uncertainty of its availability. This has created a demand for research into ways to increase mechanization and automation of harvesting, processing and utilization equipment. When such equipment exists which can produce biomass energy economically, this encourages even more enthusiasm in biomass production.

Between 1977-1982 petroleum imports in the U.S. were cut in half. Wood used for energy went from 84 million dry tons in 1973, to more than 160 million dry tons in 1984. Much of this consumption was by the wood industry.

Currently there is wood burning equipment in use by industry and homeowners that is somewhat automated. Chunk-wood is used by some industries as it requires less energy to make than chips. However, chips appear to be the most common form used in Iowa at the present time. Pelletized wood is also being used. The pellets are made using sawdust which is often mixed with a glue and put under pressure. Advantages of the pellets include less dust and insects;easier handling, as the pellets can be stored in such a way as to reduce or eliminate trips outside; and they can be economical to use. In Minnesota there are at least 30 schools using pellets to heat their facilities. The pellet burning stoves for homes are set up with an automatic feed system and can hold enough pellets to heat the home for up to a day and a half. Both of these aspects means less labor involvement than a traditional wood stove. Some of these stoves are so efficient that they can be vented using light gauge metal. Therefore, a chimney does not have to be used or cleaned.

References

Excerpts from: Wray, Paul H. 1979. Energy Plantations. F-324. Cooperative Extension Service, Iowa State University, Ames, IA 50010. Used by permission.

Ontario Ministry of Energy. 1983. Opportunity Knocks at ENERGO '83 - Ontario Energy Opportunities in Biomass. Conference papers.

Study Questions

1. Which biomass fuel use relates most directly to wood use?
2. What wood products can be used for biomass?

ENERGY PLANTATIONS*

The term "energy plantation" is used for a planting of *selected species which* are grown for the major purpose of providing fuelwood. Energy plantations are comprised of genetically improved, intensively cultivated, often closely spaced trees, which can be harvested repeatedly (after re-sprouting) on cycles of 10 years or less.

Species Selection

Producing the greatest BTU yields per acre per year is the top priority in tree selection. In Iowa the highest yielders are cottonwood and cottonwood hybrids, sycamore, silver (soft) maple, green ash, white ash, box elder, black locust, European black alder and hybrid aspen. White ash will not re-sprout after cutting and will have to be reseeded. Hybrid aspens are performing best in Iowa at this time. Silver maple is the best sprouting species, producing multiple stems.

Planting Plan

It is best to plant a number of species; no less than three, with five or more being best. Such a mix helps to reduce problems with diseases and insects. It also enables the grower to evaluate the species to determine which do best for a given soil and climate.

Spacing between rows depends on how weeds will be controlled the first 2-3 years. If mechanically cultivated, the spacing cannot be closer than the width of the equipment used.

As each species has a different growth rate, they should be planted in separate rows or in small blocks. This prevents the detrimental effects of competition which could occur if within-row species plantings were made.

Black locust and silver maple can be direct seeded, but poplar and aspen are planted as seedlings because their seeds are small and prone to drying out.

Harvesting

Harvest of the fast growing species can commence when the trees are 5-7 years old. Within a few years later, slower growing trees can be cut. The trees should be 4 to 6 inches in diameter at this time.

When harvesting, remove trees in blocks to allow for the trees to re-sprout (coppice) without excessive shading. The new sprouts will grow quicker than seedlings because a root system already exists. Re-sprouting also saves the expense of having to buy and plant seedlings. After the sprouts have grown for one season, it is desirable to allow only one or two sprouts per stump to continue to grow.

To ensure good sprouting it is essential that harvest be done after fall leaf drop has occurred. At this time food reserves in the root system are at their maximum levels, which allows for successful coppice regeneration.

Given proper management, yields of 2 1/2 to 5 tons of dry matter per acre per year are common. It is not an unreasonable possibility to get 10 ton yields.

*Reference

Excerpts from: Wray, Paul H. 1979. Energy Plantations. F-324. Cooperative Extension Service, Iowa State University, Ames, IA 50011. Used by permission.

Study Questions

1. What is an energy plantation?
2. What species should be used for an energy plantation?
3. How many species should be planted? Why?
4. What spacing is needed?
5. How many years does it take before harvesting can begin?
6. How is an energy plantation regenerated?

A FIREWOOD BUSINESS*

In any business it is important to keep the appropriate records for tax purposes. In a firewood business two types of records need to be kept: (1) a record of production costs and product income and (2) equipment costs.

Costs and Income

Records of expenses and incomes need to be kept. Costs include: the cost of firewood, cost of cutting and transporting firewood, marketing and advertising costs, and excess firewood not marketed. The income is the price per cord multiplied by the number of cords sold.

Once these basic records have been recorded, the tax treatment can be determined. Some portion of the sales of firewood may qualify for capital gains treatment. Standing timber must be held for more than six months to qualify for long-term capital gains treatment and receive the 60 percent exclusion from regular income tax (this is the case only if the firewood business is part of the total farm operation). From sales of standing timber owned less than 366 days, income is treated as short-term capital gains. Short-term capital gains income receives no exclusion and is, therefore, taxed the same as ordinary income.

The stumpage value of the wood can be eligible for capital gains. The stumpage value is the dollar value of the wood in a standing tree. To determine the stumpage value take the total number of cords and multiply it by the present fair market stumpage value. Ask your local district forester or the Iowa Utilization Forester (515/294-0445) for the current fair market stumpage value of a cord of wood.

Once the total stumpage value is determined that amount is subtracted from the total price received from the firewood. The remaining amount is taxed as ordinary income. Here is an example: You have 10 cords of wood from your woodlot. The present stumpage value is $25 per cord. Therefore, $250 will be eligble for capital gains, if the qualifications have been met. This means $100 is taxable. If the 10 cords sold for $75 per cord, then your total gross income is $750. Subtract the $250 (capital gain) from the $750 and you have $500 (less operating expenses) to be taxed as ordinary income.

Equipment Expenses

The second type of records is for the purchase of equipment. Equipment can be deducted using the appropriate depreciation schedule. You will need to keep an equipment account. This account includes the usual equipment associated with a woodland operation: chain saws, tractors, logging trucks, and skidders. These items are capital assets and should be depreciated.

Deductible operating costs include normal repair and maintenance of equipment. Major repairs that increase the life of the equipment, such as an engine overhaul, are treated as capital investments that must be depreciated.

Most of the equipment used in timber operations is eligible for investment tax credit. Both new and used property are eligible. Claim the credit in the year you acquire the property.

For property placed in service before 1981, the full credit was only available for assets held for seven years. For properly disposed of in less than seven years, part or all of the credit was recaptured.

The Economic Recovery Tax Act of 1981 altered the investment rules for property purchased after 1980. Certain property, such as cars and light trucks, are only eligble for 6 percent credit. However, most property remains eligible for the 10 percent credit. Beginning in 1983, if you claim the full credit, then you must reduce the basis for depreciation by half of the credit claimed. For more information on the investment tax credit, see IRS Publication 572, Investment Credit.

If you farm, the woodland operation is probably incidental to the farm business, and you will maintain a single farm equipment account. But if the woodland operation is a separate business, you must set up separate depreciation accounts.

*Reference

Excerpts from: Countryman, David W. and Paul H. Wray. 1984. Tax Savings on Timber Sales. Pm-1162. Cooperative Extension Service, Iowa State University, Ames, IA 50011. Used by permission.

GLOSSARY TERMS

Back cut. The last cut, placed 1"-2" above undercut, which actually fells the tree.

Biomass production. Term used to refer to plant matter produced in bulk such as wood chips, corn cobs,and various plant stalks, primarily for energy uses.

Capital gains. A tax advantage where only 40% of the dollars brought in from selling timber is taxable.

Chipper. A piece of machinery used to reduce whole pieces of wood into chips. Limbs and small diameter boles (tree stumps) can be chipped.

Energy Plantation. Term used to refer to trees of fast growth which can be used for chips, sawdust, firewood logs, etc.

Face Cord. A stack of wood with the measurement of 4 feet high and 8 feet wide but the lengths are less than 4 feet.

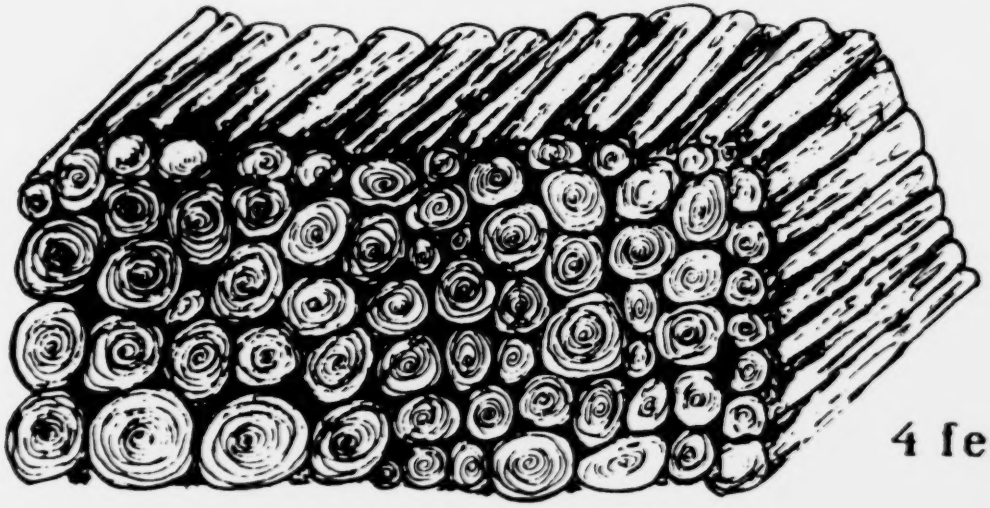
Hybrid Poplar. Genetically superior poplars bred for disease and insect resistance; tree characteristics such as growth rate and tree form; and site requirements such as drought and flood tolerance.

Standard Cord. A 4'x4'x8' stack of wood which contains 128 cubic feet of wood plus air spaces. A typical cord may be logs which are 4 feet long in a pile 4 feet high and 8 feet wide.

Timber Stand Improvement (TSI). Improving the quality of an existing timber by eliminating crooked, dead, and diseased trees; and improving the spacing between trees to reduce the amount of competition between trees.

Undercut. The first, v-shaped cut made 12"-16" above ground and in the direction the tree will fall.

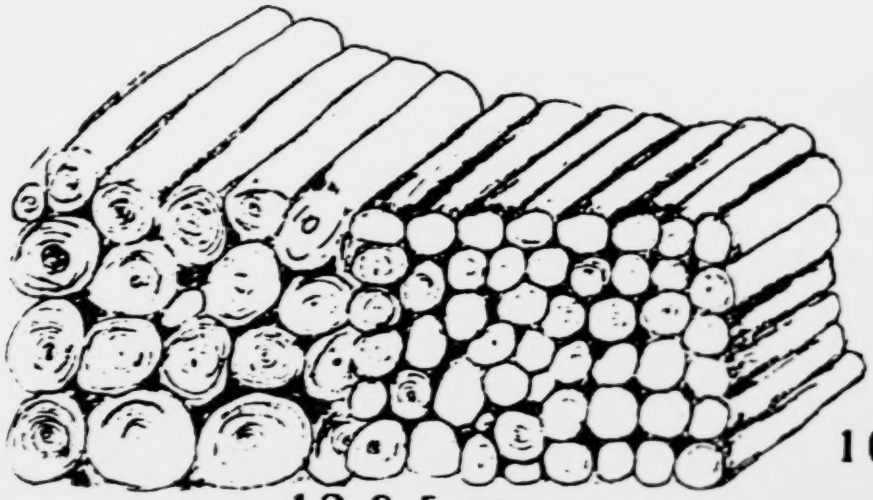
What Is A CORD?



128 cubic feet of wood and air space

Cord Determination

10 feet



10 feet

12.8 feet

Formula:

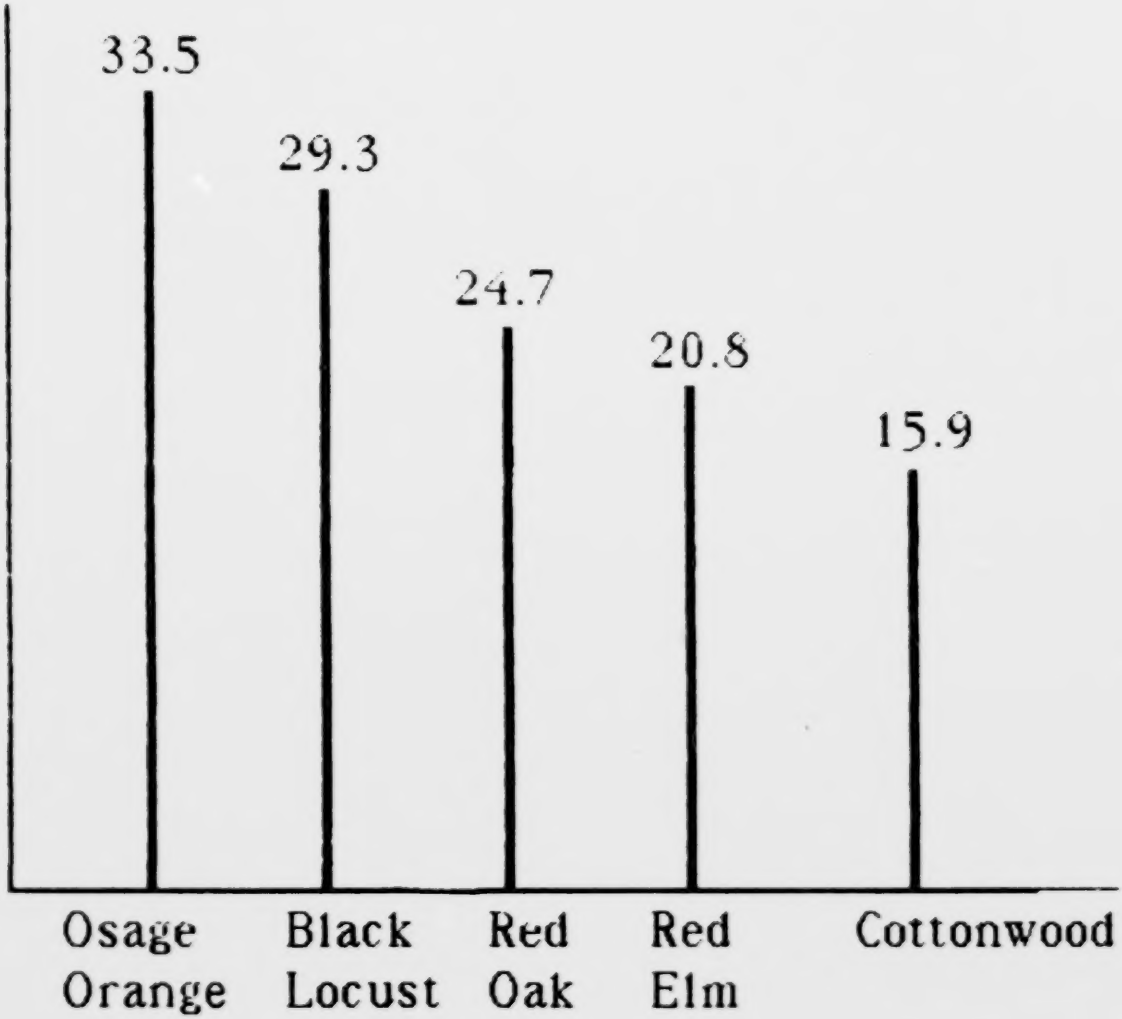
$$\frac{\text{Length x Width x Height}}{\text{128 cu. ft.}} = \text{Number of Cords}$$

Example:

$$\frac{\text{10 ft. x 10 ft. x 12.8 ft.}}{\text{128 cu. ft.}} = \frac{1280\ \text{ft}^3}{128\ \text{ft}^3} = \text{10 cords}$$

Heat Potential of Wood

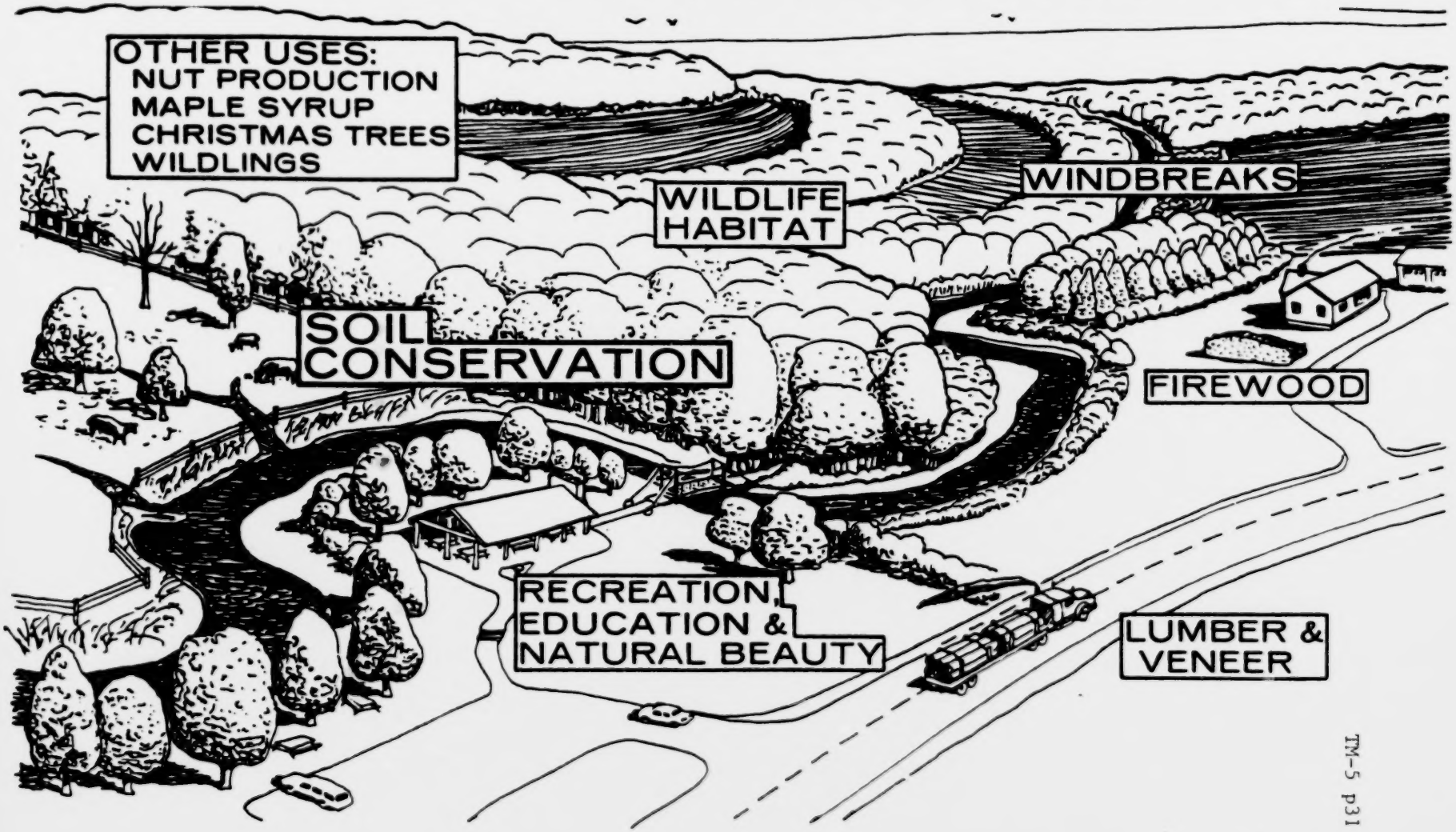
(million Btu's per cord)



Ratings for Hardwood Firewood

Species	Ease of splitting	Ease of starting	Rate of burn
Osage orange	difficult	difficult	slow
Black locust	difficult	difficult	slow
Hickory	moderate	fair	slow
Ironwood	difficult	difficult	slow
Oak	moderate	difficult	slow
Hard maple	moderate	difficult	slow
Ash	easy	fair	slow
Elm	difficult	fair	medium
Boxelder	easy	easy	fast
Aspen,cottonwood	easy	easy	fast
Willow	easy	fair	fast
Basswood	easy	easy	fast

BENEFITS OF IOWA'S WOODLANDS



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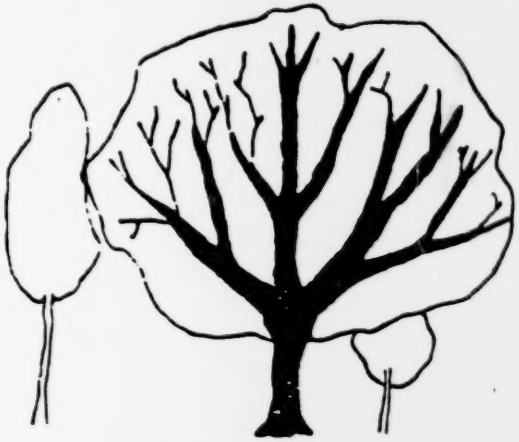
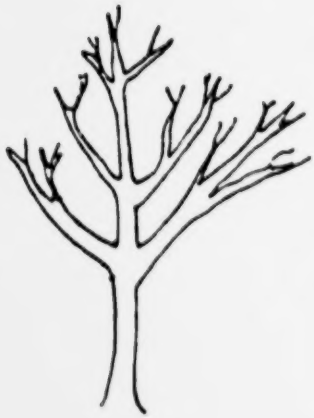
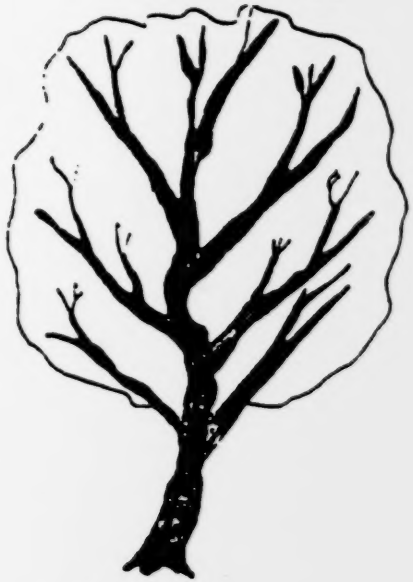
TREES TO REMOVE FOR FIREWOOD



"Wolf" tree



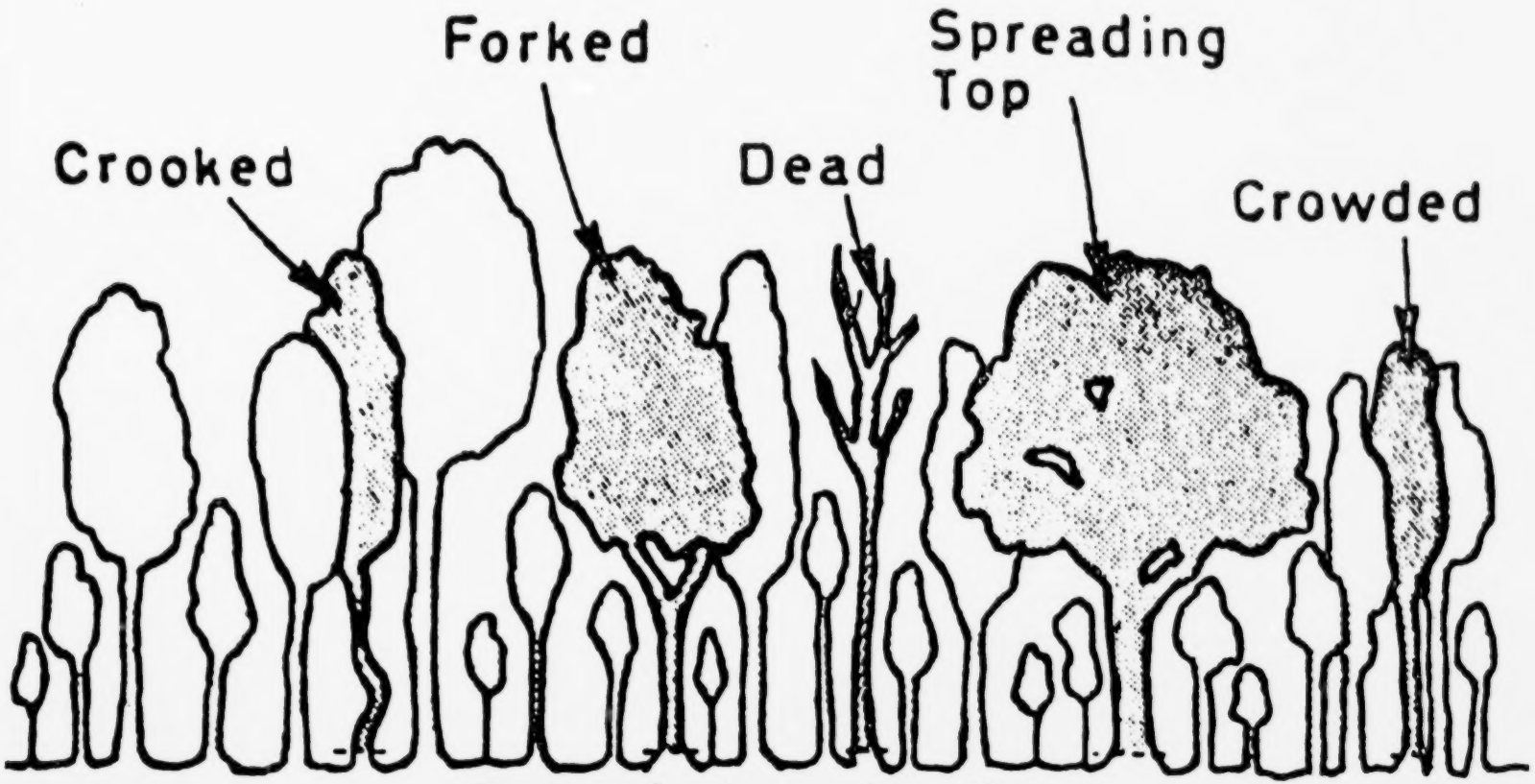
Dead/diseased



Crooked

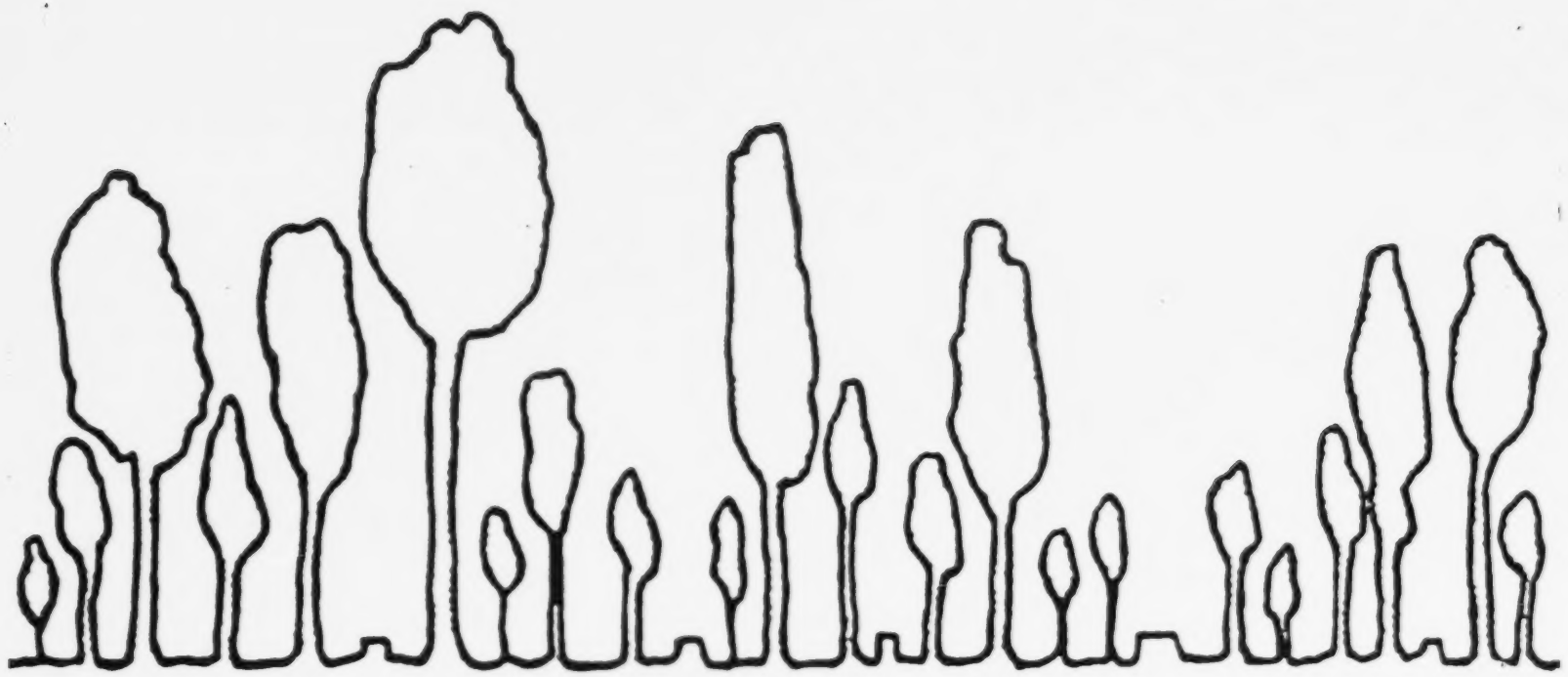
Low forked

SPACING CROP TREES



Before fuelwood cutting

SPACING CROP TREES



After fuelwood cutting

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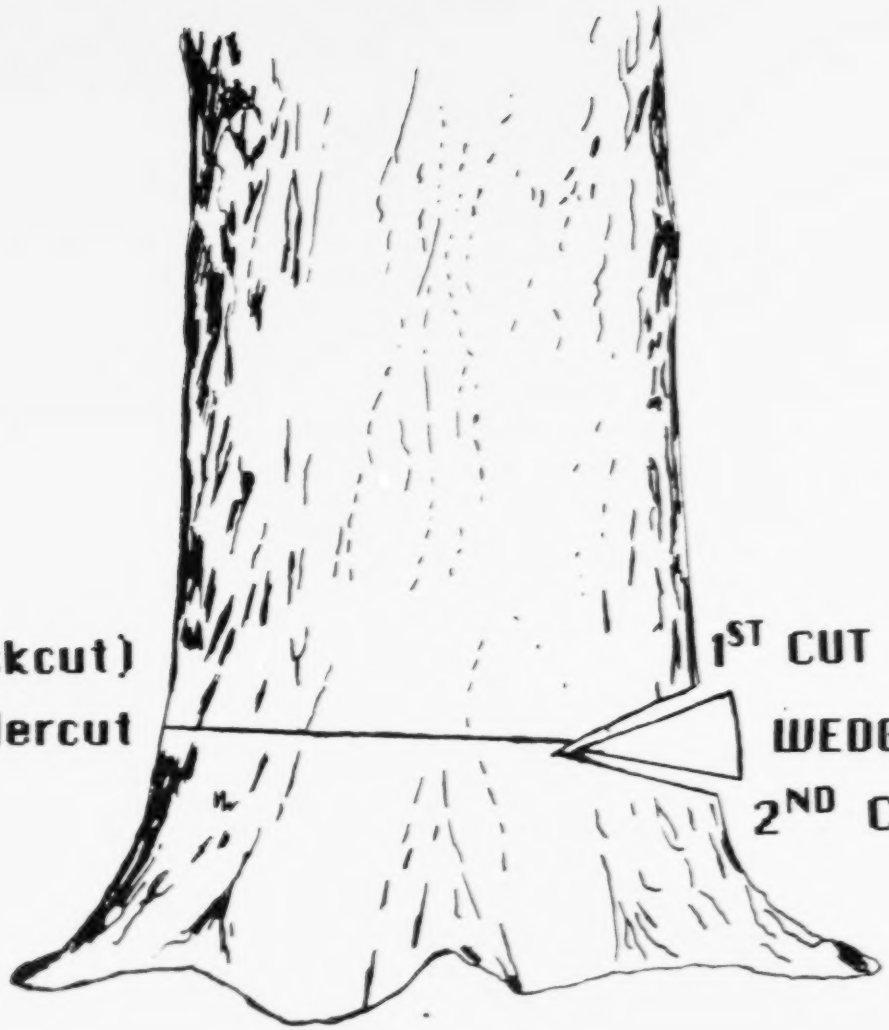
THE RIGHT CUTS



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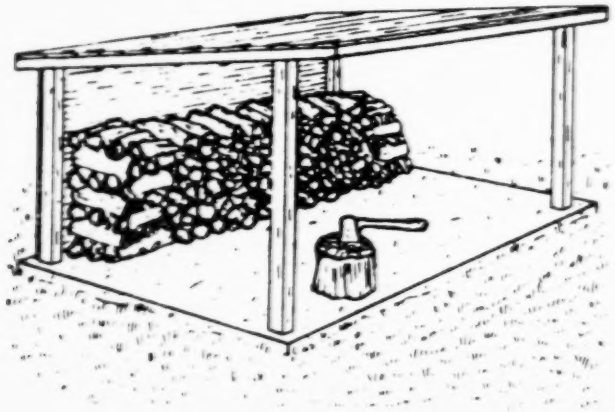
Steps in Preparing Firewood for Market

Cut



Split, stack, dry and store

Check out local market and advertise

Firewood
$40/pickup
Call 288-heat

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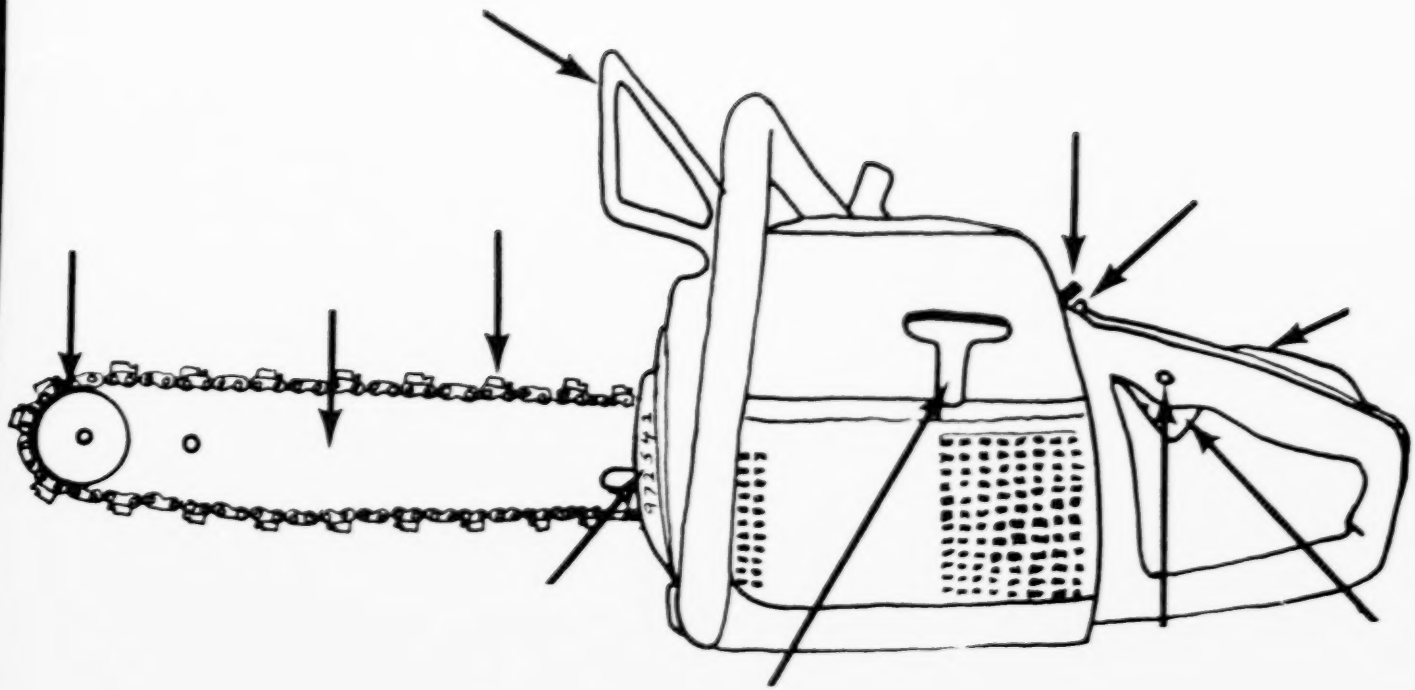
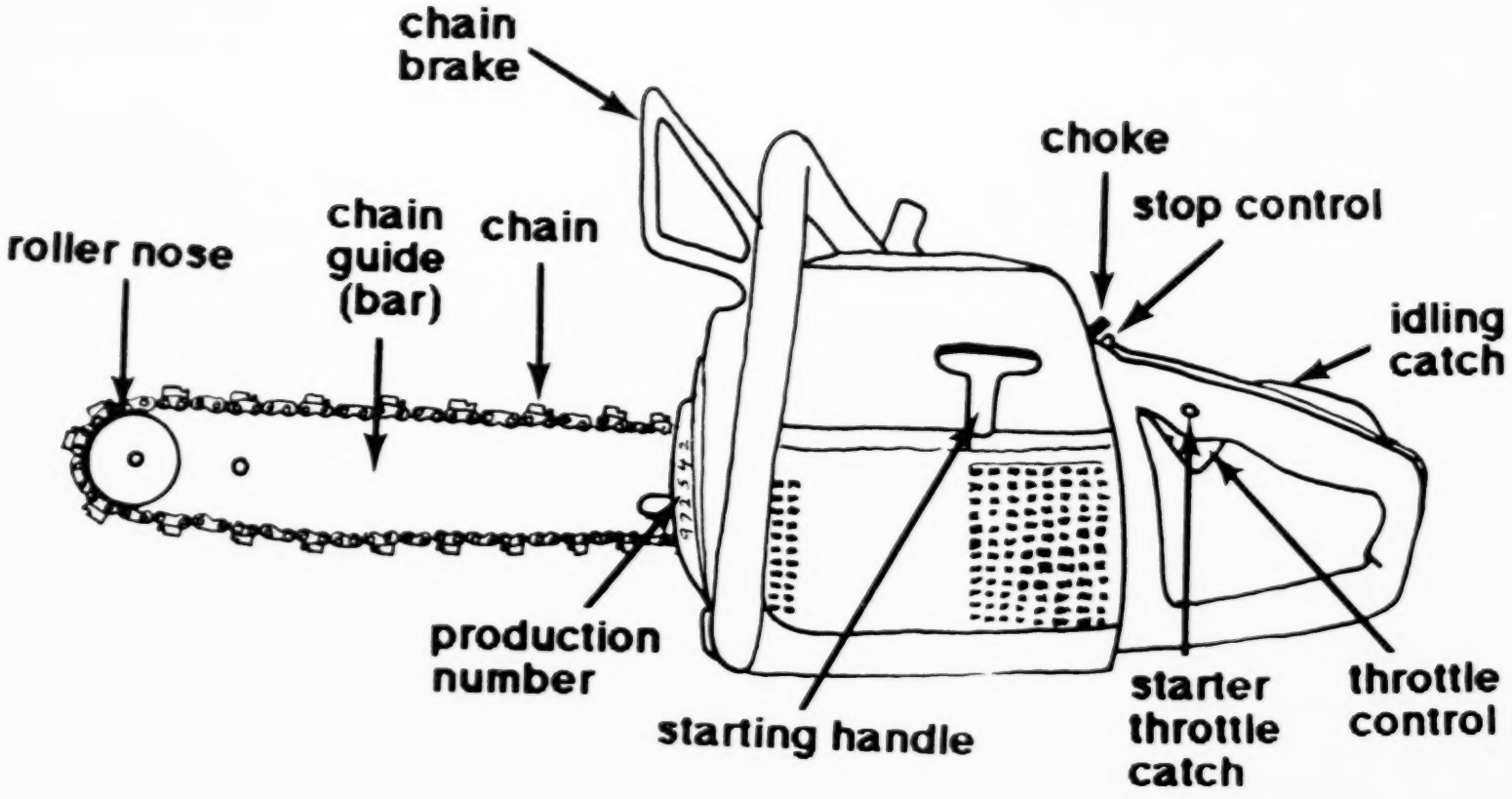
Chain Saw Parts



Chain Saw Parts



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DIFFERENT WOOD SPLITTERS

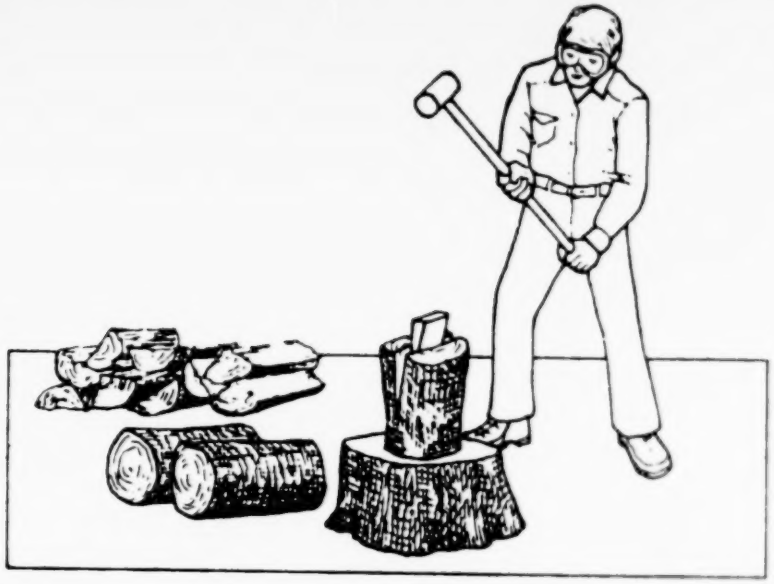
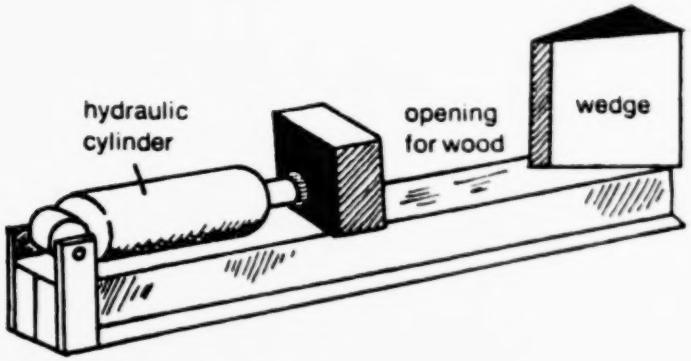
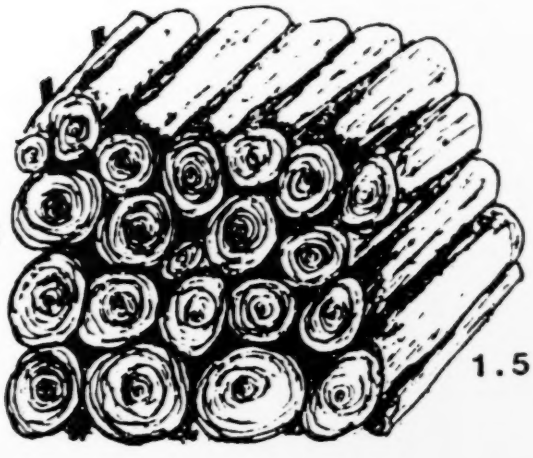
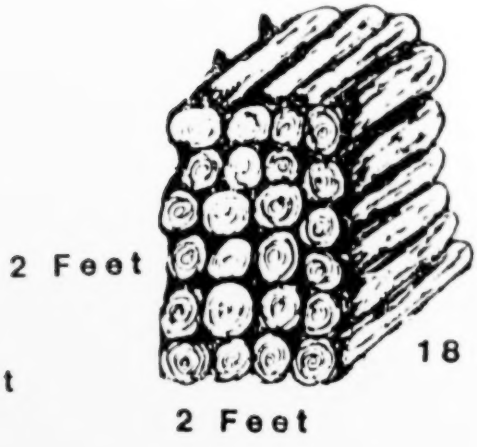


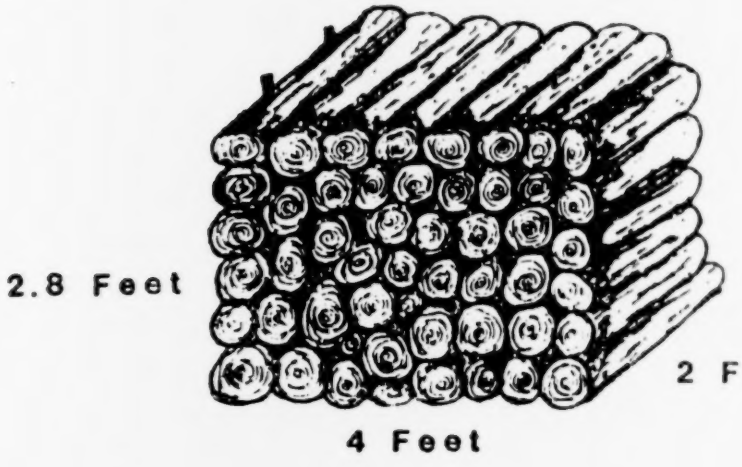
Fig. 2. Splitting wood with a maul and wedge on a chopping block.



Cord Determination

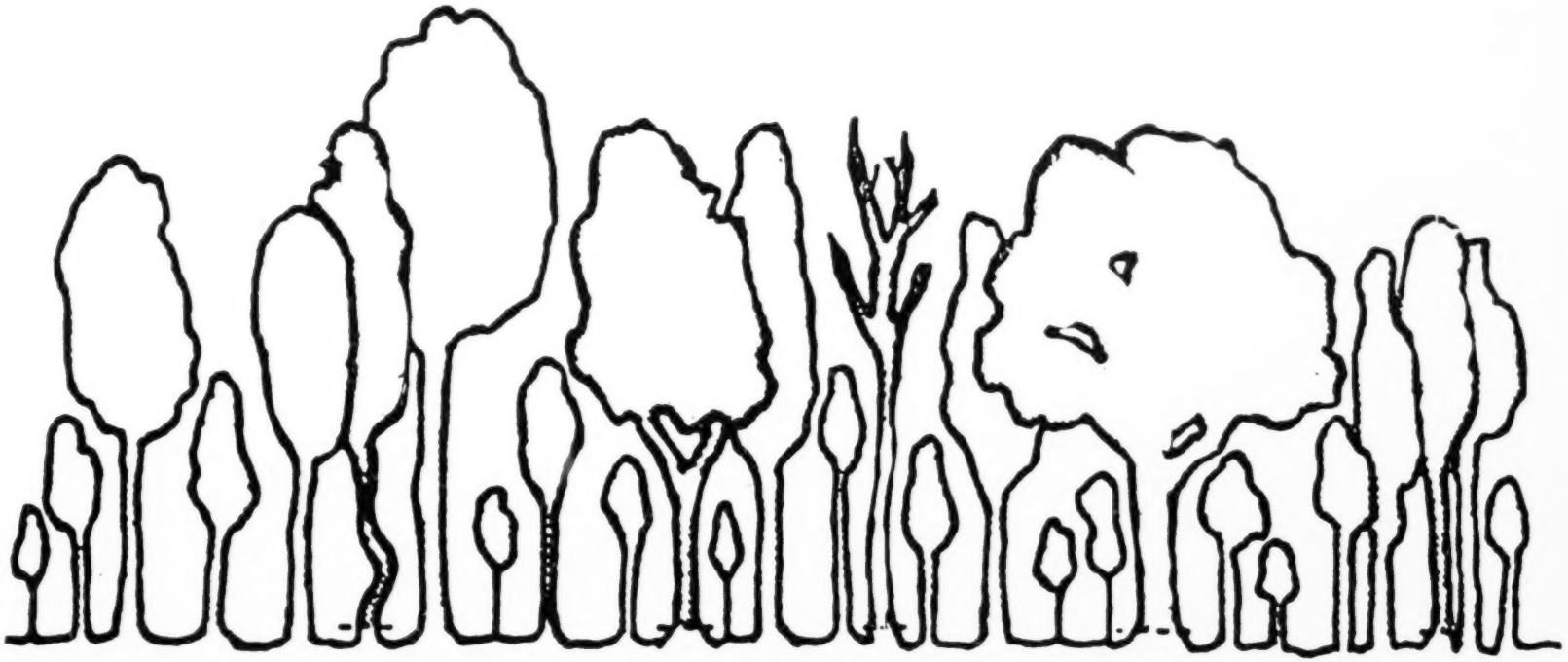






Which pile contains the most cords?

SELECTING THE RIGHT TREE



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CUT THAT FIREWOOD, SAMMY!

Situation:

Sammy Slick has been offered free!! access to a wood pile 50 miles from his home in Cheap-a-Skate Town, IA. He has also been offered access to a wood pile 10 miles from home, but it would cost him $25.00 per cord. He figures he can cut and split 1 cord of wood per 5-hour day (not including driving time).

Ever since Sammy bought his chain saw last week for $250.00, he has wanted to go into the firewood business. Heavens, you can sell a cord of firewood for $150.00! Sammy knows that if he sells two cords he'll have the chain saw paid off. This is a much faster profit than the $5.00 per hour he is making now. (He's figuring the chain saw costs approximately $1.50 for gas and oil; and that he'll be able to cut 500 cords during it's 10-year life span).

He figures transportation will cost a little. He's got a 1/2-ton Ford pickup that gets about 15 miles per gallon and can safely go 40-miles-per-hour with a half-cord of wood. Depreciation and maintenance is $1.00.

Questions:

1. Which option should Sammy Slick use - the free firewood or the $25.00 firewood?
2. Will two cords of firewood really pay for Sammy's new chain saw?
3. How much depreciation per cord will Sammy need to figure?
4. Will proper firewood production with proper drying ... bring in money faster than Sammy's present job?
5. If Sammy rents his uncle's truck for $5.00 per load, would this business deal make Sammy more money? (This truck can carry 2 cords of wood and gets 8 miles per gallon), plus $1.00 depreciation. It will go 50 mph with a full load.
6. How much money will Sammy make per cord with each of the four options?

Formula:

$$\text{COST PER CORD} = S + \left[(P/M + F)\ (ND)\right] + \left[(T + ND/R)\ (L)\right]$$

Where:
- S = chain saw cost (variable & fixed) for cutting one cord
- P = price per gallon for truck fuel
- M = miles per gallon for truck
- F = fixed cost per mile for truck
- N = number of round trip hauling distance
- T = hours required to cut, split, load and unload one cord
- R = average speed of truck during haul
- L = labor charge per hour
- D = distance to the firewood source and back home